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DEPARTMENT OF  
MINERALS AND ENERGY



BUREAU OF MINERAL RESOURCES,  
GEOLOGY AND GEOPHYSICS

Record 1973/153



MOUNT McDONALD GRAVEL SEARCH, A.C.T. - 1973

by

P.A. Lang

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## CONTENTS

	<u>Page</u>
INTRODUCTION	1
GEOLOGY	1
Previous Work	1
Geological Setting	1
FIELD INVESTIGATIONS	1
Volcanic Rocks	1
McDonald Granite	2
PROPOSED GRAVEL PITS	2
Site 1	3
Sites 2 and 3	3
CONCLUSIONS	3
RECOMMENDATIONS	4
REFERENCES	4

## APPENDICES

1.	Definitions of gravel, plastic and non-plastic	5
2.	Definitions of terms relating to gravel reserves	6
3.	Test result sheets	

## PLATES

1.	Proposed Gravel Pits Mt McDonald Area
2.	Proposed Gravel Pit No. 1 Mt McDonald Area
3.	Proposed Gravel Pits Mt McDonald Area

## SUMMARY

In response to a request from the Department of the Interior (now the Department of the Capital Territory) the Bureau of Mineral Resources undertook a search for sources of 'plastic' and 'non plastic gravel' within a 4 km radius of Mt McDonald, A.C.T.

Completely weathered volcanic rocks in the area were found to have an unacceptable plasticity index (too high) , and an unacceptable grainsize grading (deficient in coarse fractions). Slopewash derived from the volcanic rocks was also found to be deficient in coarse fractions.

The McDonald Granite weathers to produce a 'gravel' with a lower plasticity index and an acceptable grainsize grading. Generally the McDonald Granite is completely weathered to depths ranging from 60 cm to 130 cms.

The areas where completely weathered granite extends to depths between 2 and 4 metres were selected for sampling for plasticity index, grading and compraction tests.

Inferred reserves based on depth to hand auger refusal are estimated to be 10 000 - 12 000 m<sup>3</sup> of 'plastic gravel' (Site 1), 5000-7000 m<sup>3</sup> of 'plastic gravel' (Site 2) and 10 000 m<sup>3</sup> of 'non plastic gravel' (Site 3).

## INTRODUCTION

In June 1970 the Department of the Interior (now the Department of the Capital Territory) requested the Bureau of Mineral Resources (BMR) to undertake a systematic search for sources of 'plastic' and 'nonplastic gravel' in a number of areas in the Australian Capital Territory (see Appendix 1 for explanation of types of gravel). This report details the search within a 4 km radius of Mount McDonald (Plate 1).

The location of the Mount McDonald 'gravel' deposits is shown on Plate 1. The deposits are approximately 18 km west of Canberra City.

Constraints imposed by the Department of the Interior on the location of gravel pits are as follows:

- 1) Pits should be less than 8 km from the roadworks.
- 2) Pits should be accessible from existing roads.
- 3) Pits should not be located on freehold land.
- 4) Pits should not be readily visible from existing roads.

## GEOLOGY

### Previous Work

The area was mapped in detail by D.K. Malcolm (1954) and is included in the Canberra Geological Sheet SI/55-16 (Strusz, 1971).

### Geological Setting

The rocks in the area west of the Murrumbidgee River and within 4 km of Mount McDonald form the Walker, Tarpaulin Creek, and Swamp Creek Members of the Uriarra Volcanics, and the McDonald Granite (Malcolm, 1954).

## FIELD INVESTIGATIONS

### Volcanic Rocks

Decomposed volcanic rocks in the Mount McDonald area (Walker and Swamp Creek members) are unsuitable for "gravel". Maximum grain-size in the parent rock is too fine to give the coarse sand and gravel

fractions, and the plasticity index of the in situ, weathered volcanics is too high. Plasticity index of the slopewash derived from the volcanics is fairly low, but the material is deficient in coarse fractions.

### McDonald Granite

Six separate 'gravel' pits in the Mount McDonald area are located on the McDonald Granite. The preferred location of previous gravel pits on the McDonald Granite, and BMR tests (Appendix 3) on 'gravel' samples from decomposed McDonald granite indicate that this rock type has a satisfactory chemical composition (i.e. low in biotite and calcic plagioclase, which give rise to plastic clays) and a grainsize-grading acceptable to Commonwealth Department of Works (CDW).

The contacts of the granite were mapped, and areas of deep weathering were sought using aerial photo-interpretation, geomorphological indications, and hand augering.

In the forest areas on Mount McDonald, the granite is generally completely weathered to depths ranging from 60 cm to 100 cm. Small pockets where the granite has been weathered to greater depths have already been exploited for 'gravel'.

On POR 168 and POR 100 Urayarra, (Plate 1) the granite is generally completely weathered to depths ranging from 60 cm to 130 cm, but there are some deeper pockets of completely weathered rock on the northeastern slopes, where 2 to 4 metres of 'gravel' could be obtained.

In general the granite is more deeply weathered beneath surface depressions, but white and mottled red and yellow clays have developed in these areas, and the material is too plastic for use as 'gravel'.

### PROPOSED GRAVEL PITS

Three sites for 'gravel' pits were selected for testing (1, 2, and 3 in Plate 1). Hand auger holes were sunk to refusal, and samples were tested for plasticity index, grading, and compaction. Plates 2 and 3 show the locations and details of auger holes. Results of plasticity index, grading, and compaction tests are included in Appendix 3.

To calculate reserves, the thickness of deposits was taken as the depth to hand auger refusal. A power-auger penetrated to greater depth and so reserves would be much greater if calculated to power-auger refusal. However, the power-auger can penetrate highly weathered rock which may be too hard for use as gravel.

Liquid limit in all samples is high owing to the presence of about 3 percent of chlorite in the weathered granite.

Site 1 - This proposed pit has inferred reserves (see Appendix 2) of 10 000 to 12 000 m<sup>3</sup> of 'plastic gravel'. Plasticity index ranges from 5 to 9. Grading curves plot within the CDW specifications (see Appendix 3, holes HA21 to HA27). Liquid limit ranges from 26 to 28.

The proposed site is visible from the Mount McDonald road for about 200 m, but it is within an area resumed for pine-forestation and could eventually be screened from the road by trees. The pit is accessible from the Mount McDonald road.

#### Sites 2 and 3

Site 2 - This proposed pit has inferred reserves of 5000 to 7000 m<sup>3</sup> of 'plastic gravel'. Plasticity index ranges from 2 to 10 (holes HA37 to HA42). Liquid limit ranges from 26 to 35. Grading is within CDW specifications.

Site 3 - This proposed pit has inferred reserves of 10 000 m<sup>3</sup> of 'non-plastic gravel'. Plasticity index ranges from 3 to 10 (holes HA43 to HA46). Liquid limit is high and ranges from 25 to 27. Grading is within CDW specifications.

Sites 2 and 3 are adjacent, but separated by a clayey depression about 30 metres wide. Neither site can be seen from any public roads, and an access road about 1.3 km long would be required.

### CONCLUSIONS

1. Material suitable for use as 'gravel' is present in the Mount McDonald area.
2. There are three suitable sites for gravel pits.
3. Inferred reserves at the sites are 10 000 - 12 000 m<sup>3</sup> of 'plastic gravel' (Site 1), 5000 - 7000 m<sup>3</sup> of 'plastic gravel' (Site 2), and 10 000 m<sup>3</sup> of 'non-plastic gravel' (Site 3).

### RECOMMENDATIONS

It is recommended that additional augering and testing be carried out to determine the indicated reserves (see Appendix 2) of the three areas, and that the suitability of the material for use as 'plastic' and 'non-plastic' gravel be examined in more detail.

### REFERENCES

- MALCOLM, D.K., 1954 - The geology of the Cotter River and Uriarra area, Australian Capital Territory. Bur. Miner. Resour. Aust. Rec. 1954/71 (unpubl.).
- STRUSZ, D.L., 1971 - Canberra, Australian Capital Territory and New South Wales - 1:250 000 Geological Series Map. Bur. Miner. Resour. Aust., explan. Notes, SI/55-16.



## APPENDIX 1

### DEFINITIONS OF GRAVEL, PLASTIC AND NON-PLASTIC

'Gravel' is used in this report in an engineering rather than geological sense. It is defined as an unconsolidated well-graded mixture of gravel-sized rock fragments and/or mineral grains such as quartz and feldspars, together with sand and silt, in a feebly plastic soil binder. It should be stressed that the terms gravel, sand, and silt refer only to particle size according to the Unified Soil Classification System, and not to their mode of origin.

'Gravel' derives its strength from mechanical interlock owing to high internal friction of its subangular components, and specifications have been designed by CDW for quality control. These specifications are based on the assumption that the performance of 'gravel' is influenced by two characteristics: particle size distribution and plasticity. The latter is determined by an empirical test which indicates the affinity of the material for water and thereby the potential volume change of the clay binder. Particle-size limits are flexible, but the grading should be smooth and parabolic.

#### 'Plastic' and 'non-plastic gravel'

There are two types of gravel required for rural roads; in engineering terminology they are known as 'plastic gravel' and 'non-plastic gravel'. 'Plastic gravel' is used for surfacing unsealed roads and for shoulders on sealed roads. Its plasticity index (PI) should not exceed 8 and its maximum particle size should not exceed 3.8 cm in diameter. 'Non-plastic gravel' is used as a surface course underneath a seal and its PI must not exceed 6 and its maximum particle size should not exceed 3.8 cm.

In general, the 'plastic' variety should have a higher percentage of fine-grained material than the 'non-plastic' type because vehicle traffic tends to remove a considerable portion of the finer-grained material.

## APPENDIX 2

### DEFINITION OF TERMS RELATING TO GRAVEL RESERVES

Reserves are classified as 'measured', 'indicated', and 'inferred', according to the following definitions:

Measured reserves are those for which volume is computed from dimensions revealed in outcrops, trenches, workings, and drill holes, and for which the quality is computed from the results of detailed sampling. The sites for inspection, sampling, and measurement are spaced so closely and the geologic character is so well defined that size, shape, and mineral content are well established. The computed volume and quality are judged to be accurate within limits which are stated, and no such limit is judged to be different from the computed volume or quality by more than 20 percent.

Indicated reserves are those for which volume and quality are computed partly from specific measurements and analysed samples, and partly from projection for a reasonable distance on geological evidence. The sites available for inspection, measurement, and sampling are too widely or otherwise inappropriately spaced to permit the gravel bodies to be outlined completely or the quality to be established throughout.

Inferred reserves are those for which quantitative estimates are based largely on broad knowledge of the geological character of the deposit, and for which there are few, if any, samples or measurements. The estimates are based on an assumed continuity or repetition, of which there is geological evidence; this evidence may include comparison with deposits of similar type. Bodies that are completely concealed may be included if there is specific geological evidence of their presence. Estimates of inferred reserves should include a statement of the special limits within which the inferred material may lie.

The progression from measured to inferred reserves represents a progression from estimates based largely on measurable data to those based largely on judgement; and the calculations under this classification thus represent the authors' personal appraisal of the quantity and quality of their information and the relative degree of proof of the existence of the reserves estimated. Moreover 'inferred reserves' allows for new discoveries only to a limited degree.

**APPENDIX 3**

**TEST RESULTS**

COMMONWEALTH OF AUSTRALIA  
DEPARTMENT OF MINERALS AND ENERGY — BUREAU OF MINERAL RESOURCES  
A.C.T. ENGINEERING GEOLOGY

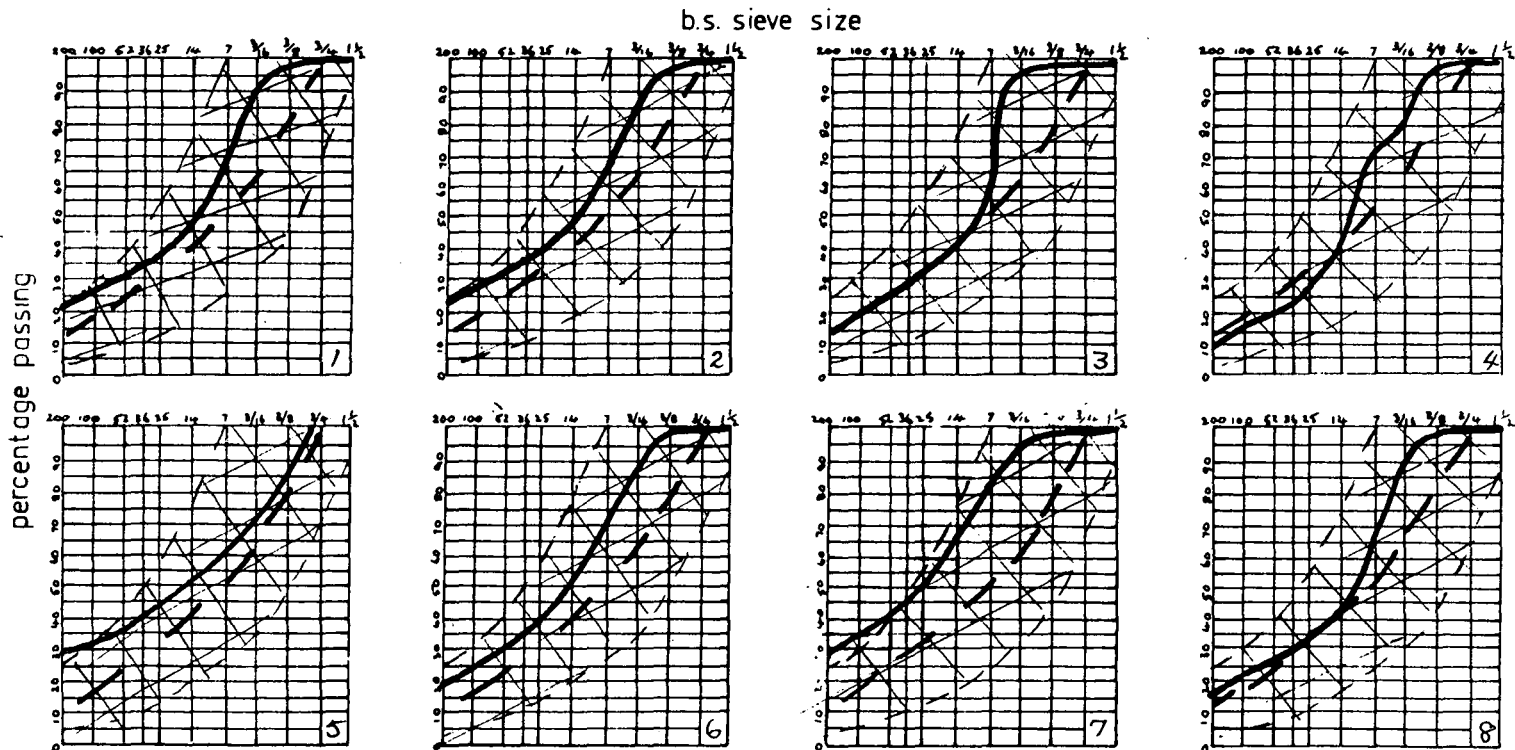
TEST RESULT SHEET

Investigation: RURAL ROADS GRAVEL INVESTIGATION (1972-1353)  
Location: MOUNT MACDONALD  
Sample Description(s): COMPLETELY WEATHERED GRANITE PORPHYRY

Bore No.	HA 21	HA 22	HA 23	HA 25	HA 27	HA 27	HA 37	HA 38
Depth	3'6" - 4'	3' - 3.5'	3'	3'	3' 6"	5'	4'	6'
Sample No.	1	2	3	4	5	6	7	8

Lower Liquid Limit		28	28	26	28	26		32
Lower Plastic Limit		20	20	21	19	21		22
Plasticity Index		8	8	5	9	5		10
Linear Shrinkage		5	5	3	5	4		7

Particle Size Analyses:



Reference -

- Sample grading curve
- - - Ideal grading curve
- CDW grading limits

COMMONWEALTH OF AUSTRALIA  
DEPARTMENT OF MINERALS AND ENERGY — BUREAU OF MINERAL RESOURCES  
A.C.T. ENGINEERING GEOLOGY

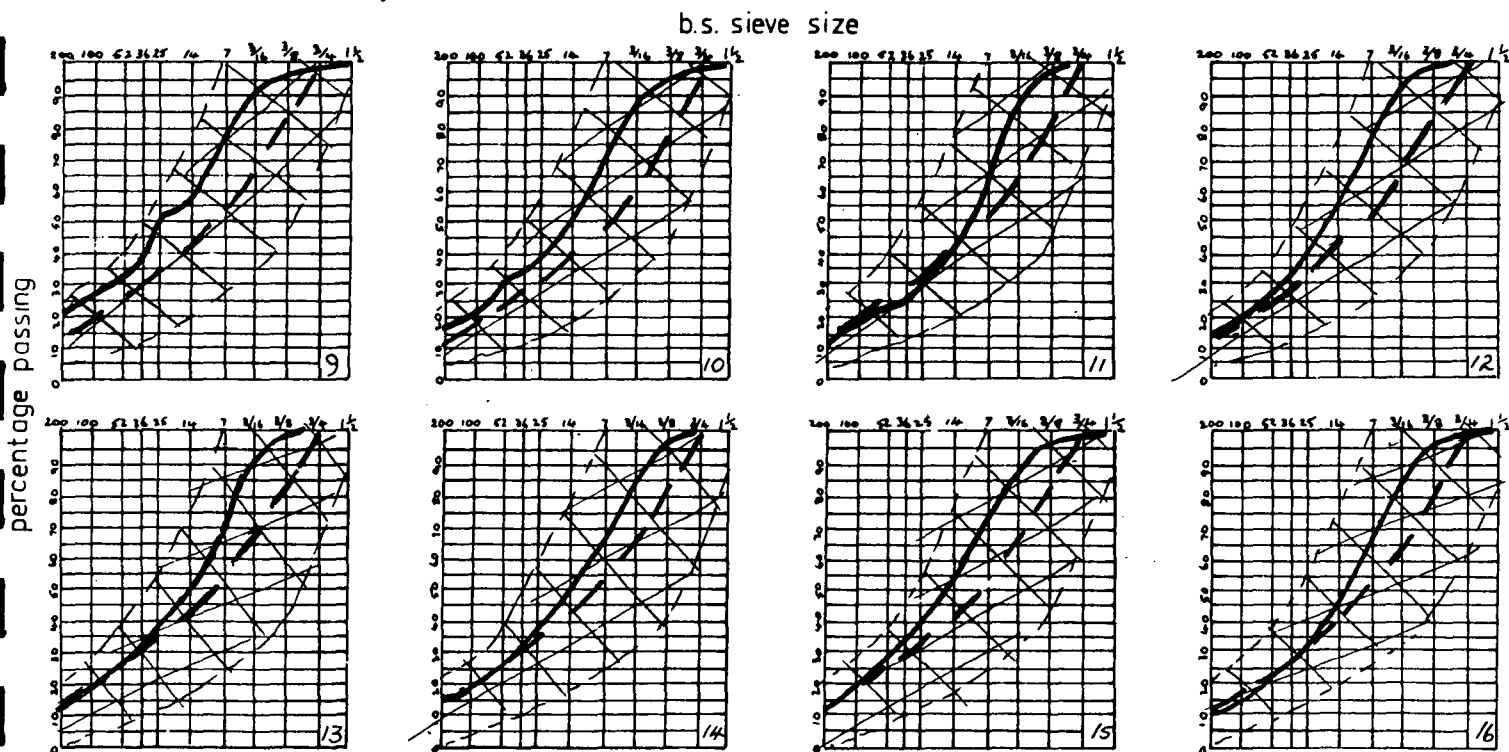
TEST RESULT SHEET

Investigation: RURAL ROADS INVESTIGATION (1972-1353) -----  
Location: MOUNT MACDONALD -----  
Sample Description(s): COMPLETELY WEATHERED GRANITE PORPHYRY  
-----

Bore No.	HA40	HA40	HA42	HA42	HA43	HA43	HA44	HA44
Depth	3'	6'	3'	6'	4'	8'	5'	8'
Sample No.	9	10	11	12	13	14	15	16

Lower Liquid Limit	26	26	35	34		27	25	
Lower Plastic Limit	24	21	27	26		22	21	
Plasticity Index	2	5	8	8		5	4	
Linear Shrinkage	2	3	4	4		4	3	

Particle Size Analyses:



Reference -

- Sample grading curve
- - - - Ideal grading curve
- CDW grading limits

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DEPARTMENT OF MINERALS AND ENERGY — BUREAU OF MINERAL RESOURCES  
A.C.T. ENGINEERING GEOLOGY

TEST RESULT SHEET

Investigation: RURAL ROADS GRAVEL INVESTIGATION (1972-1353)

Location: MOUNT MACDONALD

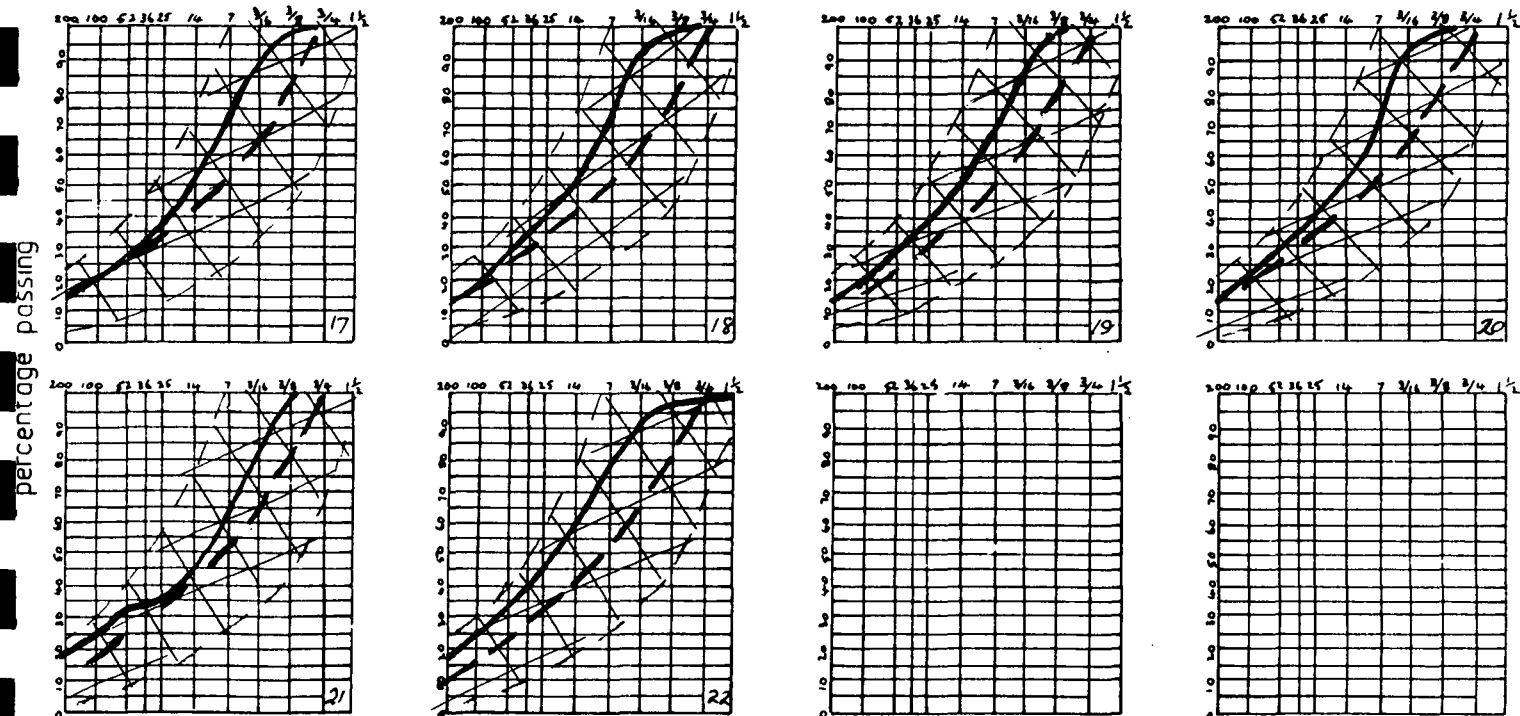
Sample Description(s): COMPLETELY WEATHERED GRANITE PORPHYRY

Bore No.	HA44	HA45	HA45	HA45	HA46	HA46		
Depth	10'	3'	4'	6'	3'	8' 6"		
Sample No.	17	18	19	20	21	22		

Lower Liquid Limit	25	26		25	27	26		
Lower Plastic Limit	20	23		20	20	16		
Plasticity Index	5	3		5	7	10		
Linear Shrinkage	4	3		4	5	6		

Particle Size Analyses:

b.s. sieve size



Reference -

- Sample grading curve
- - - Ideal grading curve
- CDW grading limits

COMMONWEALTH OF AUSTRALIA  
DEPARTMENT OF MINERALS AND ENERGY — BUREAU OF MINERAL RESOURCES  
ACT. ENGINEERING GEOLOGY

MODIFIED COMPACTION TEST

Investigation: RURAL ROADS GRAVEL SURVEY (1972-1953)

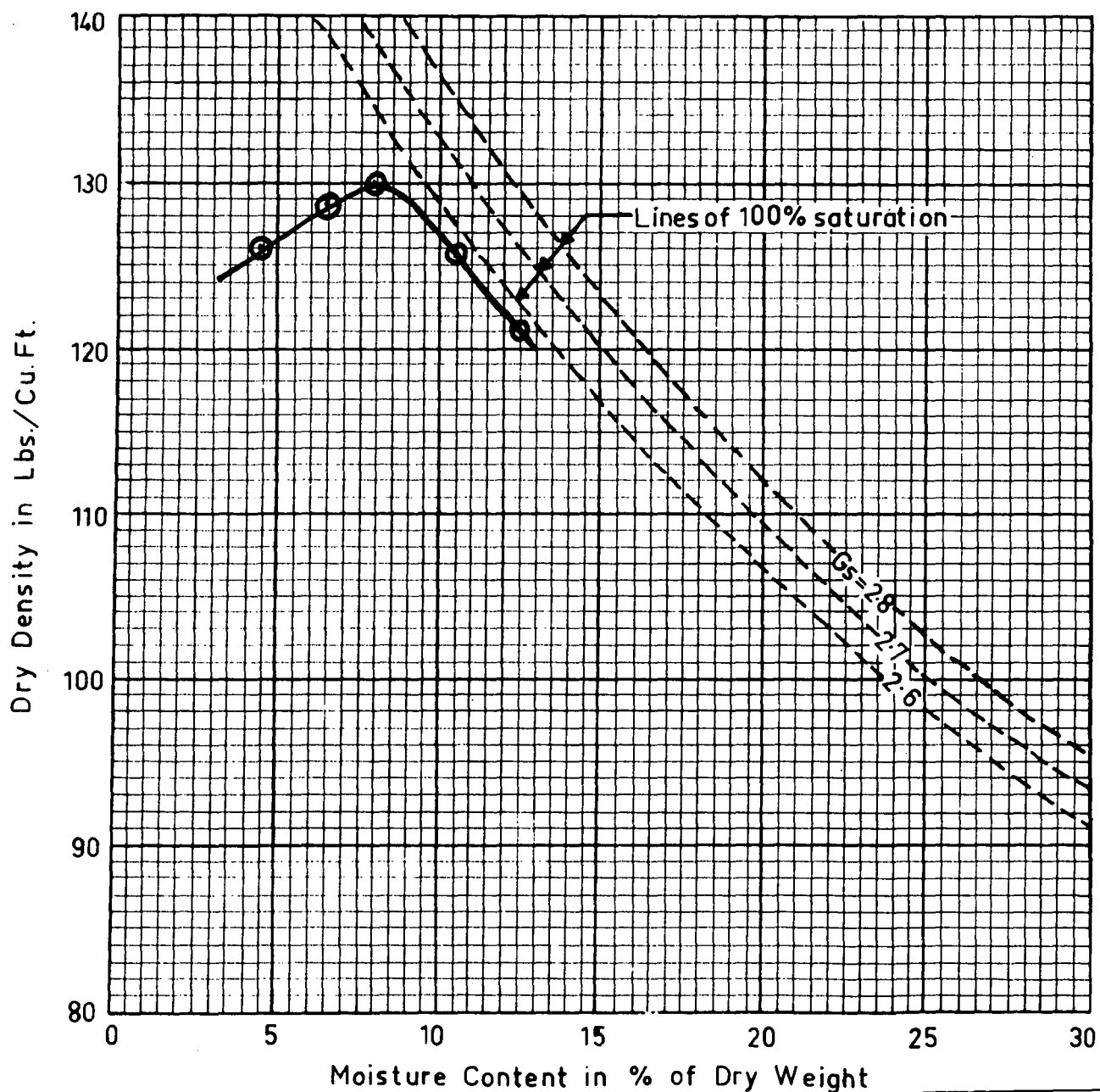
Location: MOUNT MACDONALD

Sample Description: COMPLETELY WEATHERED GRANITE PORPHYRY

Bore No.	TP2
Depth	5'
Sample No.	2

MAXIMUM DRY DENSITY 130 pcf.

OPTIMUM MOISTURE CONTENT 8%



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MODIFIED COMPACTION TEST

Investigation: RURAL ROADS GRAVEL SURVEY (1972-1973) — — —

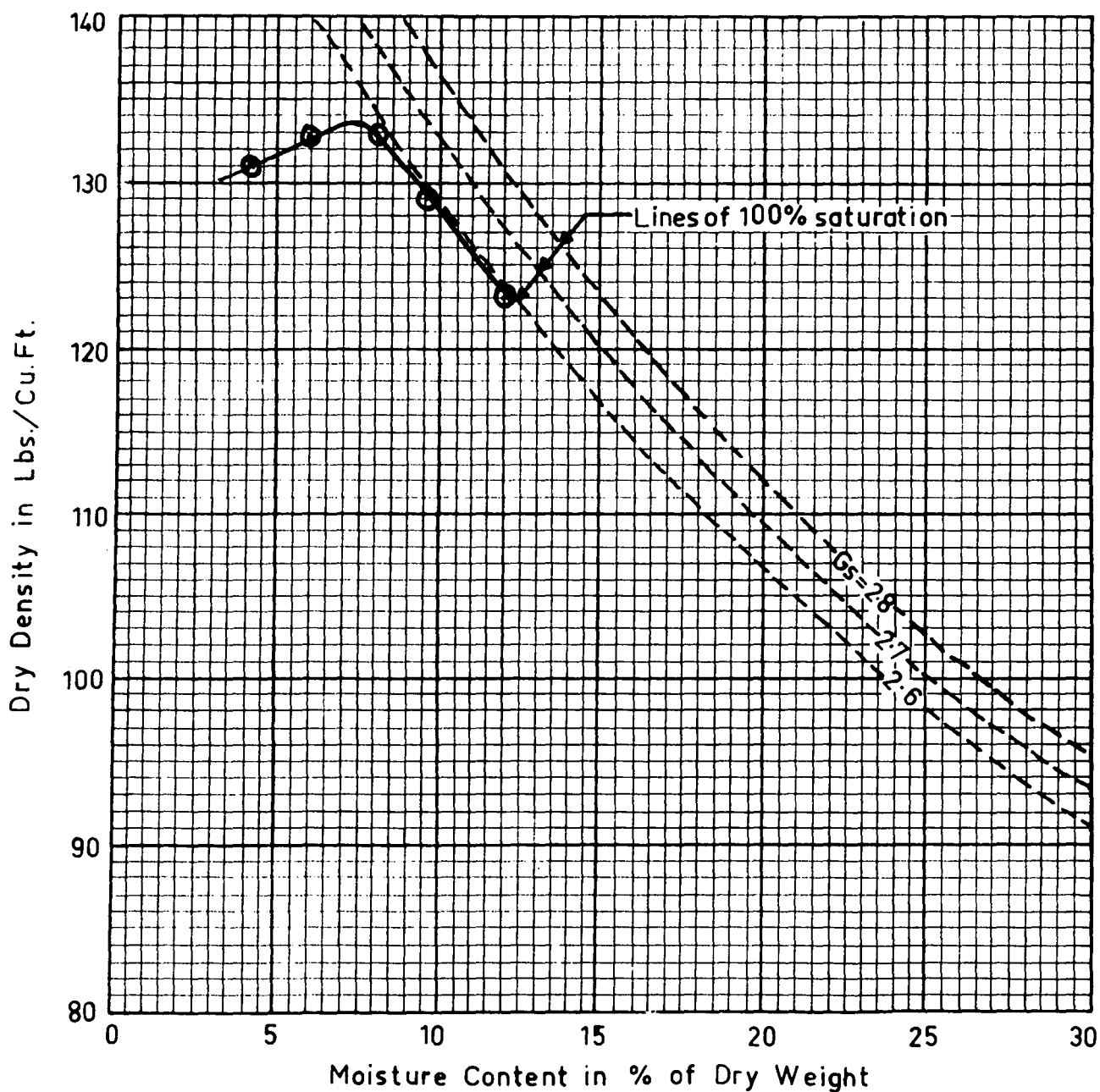
Location: MOUNT MACDONALD — — — — —

Sample Description: COMPLETELY WEATHERED GRANITE PORPHYRY

Bore No.	TP1.
Depth	4.5'
Sample No.	1

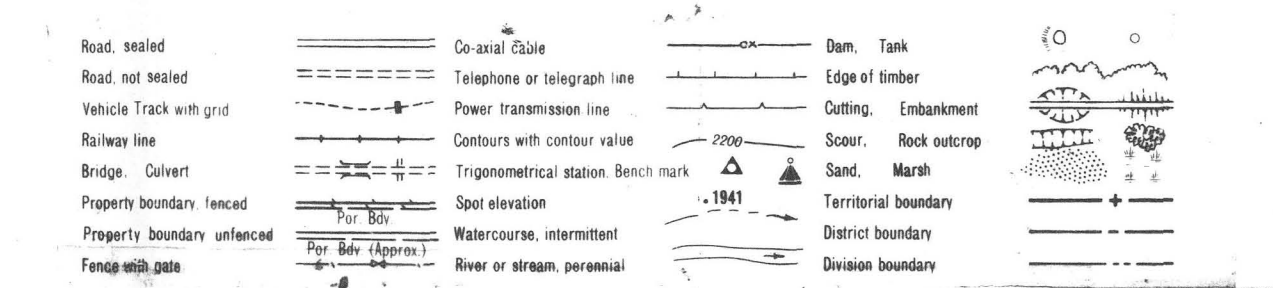
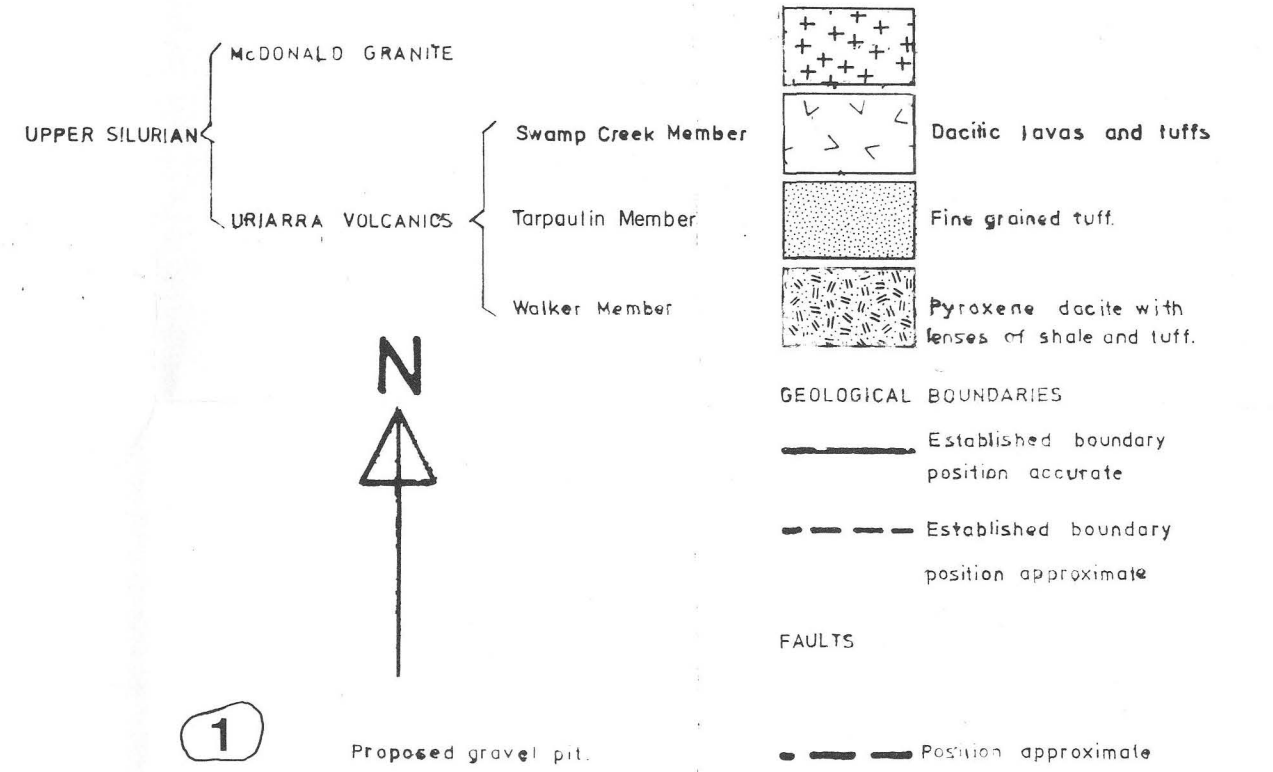
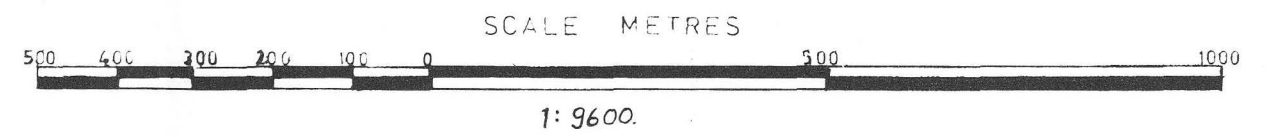
MAXIMUM DRY DENSITY 133.5 pcf

OPTIMUM MOISTURE CONTENT 7.5%

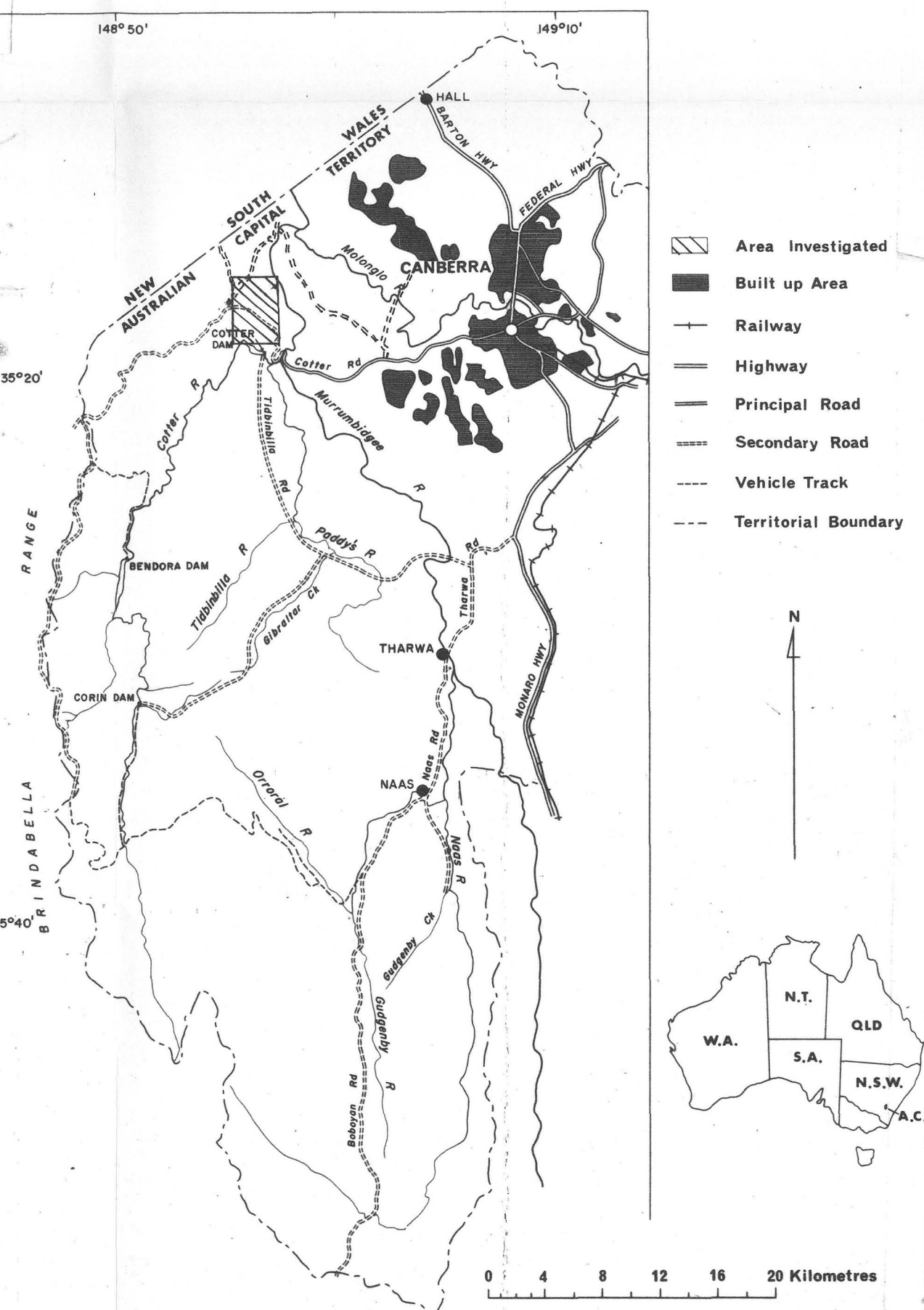




# PROPOSED GRAVEL PITS MT. McDONALD AREA



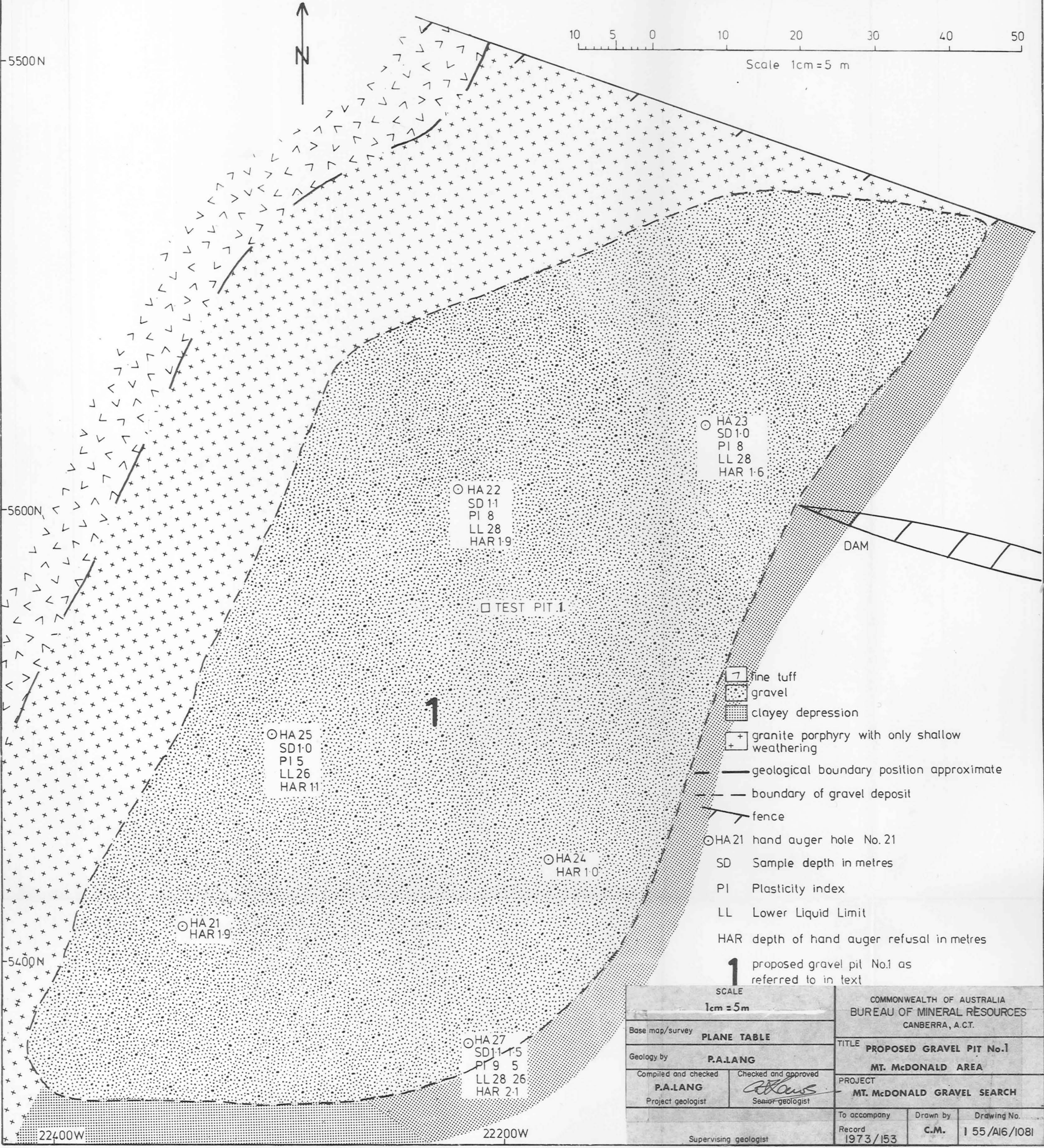
## LOCALITY MAP



AMENDMENTS			SCALE		COMMONWEALTH OF AUSTRALIA		
No.	Description	Author/Checked	1:9600		BUREAU OF MINERAL RESOURCES		
A1			Base map/survey A.C.T. P35		CANBERRA, A.C.T.		
A2			Geology by P. LANG		TITLE PROPOSED GRAVEL PITS		
A3			Compiled and checked P. LANG		MT. McDONALD AREA		
A4			Project geologist		PROJECT MT. McDONALD GRAVEL SEARCH		
A5			Checked and approved		To accompany		
			Supervising geologist		Record 1973/153		
					Drawing No. 155/A16/1080		



# PLATE 2 PROPOSED GRAVEL PIT No.1 MT. McDONALD AREA



HA 23  
SD 10  
PI 8  
LL 28  
HAR 16

HA 22  
SD 11  
PI 8  
LL 28  
HAR 19

HA 25  
SD 10  
PI 5  
LL 26  
HAR 11

HA 21  
HAR 19

HA 24  
HAR 10

HA 27  
SD 11.5  
PI 9.5  
LL 28.26  
HAR 2.1

- 7 fine tuff
- gravel
- clayey depression
- + granite porphyry with only shallow weathering
- geological boundary position approximate
- - - boundary of gravel deposit
- fence
- HA 21 hand auger hole No. 21
- SD Sample depth in metres
- PI Plasticity index
- LL Lower Liquid Limit
- HAR depth of hand auger refusal in metres
- 1 proposed gravel pit No.1 as referred to in text

SCALE 1cm = 5m		COMMONWEALTH OF AUSTRALIA BUREAU OF MINERAL RESOURCES CANBERRA, A.C.T.		
Base map/survey PLANE TABLE		TITLE PROPOSED GRAVEL PIT No.1 MT. McDONALD AREA		
Geology by P.A. LANG		PROJECT MT. McDONALD GRAVEL SEARCH		
Compiled and checked P.A. LANG Project geologist	Checked and approved <i>[Signature]</i> Senior geologist	To accompany Record 1973/153	Drawn by C.M.	Drawing No. 1 55/A16/1081
Supervising geologist				



# PLATE 3 PROPOSED GRAVEL PITS MT. McDONALD AREA

9800N

9600N

9400N

9200N

21200W

21000W

10 5 0 10 20 30 40 50  
Scale 1cm = 5 m



○ HA 46  
SD 10 27  
PI 7 10  
LL 27 26  
HAR 16

○ HA 45  
SD 10 22  
PI 3 5  
LL 26 25  
HAR 28

□ TEST PIT 2

○ HA 43  
SD 25  
PI 5  
LL 27  
HAR 31

○ HA 44  
SD 15 3.0  
PI 4 5  
LL 25 25  
HAR 3.0

○ HA 39

○ HA 38  
SD 19  
PI 10  
LL 32  
HAR 3.0

○ HA 37  
HAR 12

○ HA 42  
SD 10 1.9  
PI 8 8  
LL 35 34  
HAR 24

○ HA 40  
SD 10 1.9  
PI 2 5  
LL 26 26  
HAR 1.9

○ HA 41  
HAR 0.5

- granite porphyry with only shallow weathering
- fine tuff
- gravel
- clayey depression
- Porphyry granite outcrop
- geological boundary position approximate
- gravel/rock/clayey depression boundary
- HA 43 hand auger hole No. 43
- SD Sample depth in metres
- PI Plasticity index
- LL Lower Liquid Limit
- HAR depth of hand auger refusal in metres
- 3** proposed gravel pit No. 3 as referred to in text

SCALE 1cm = 5m		COMMONWEALTH OF AUSTRALIA BUREAU OF MINERAL RESOURCES CANBERRA, A.C.T.	
Base map/survey <b>PLANE TABLE</b>		TITLE <b>PROPOSED GRAVEL PITS MT. McDONALD AREA</b>	
Geology by <b>P.A. LANG</b>		PROJECT <b>MT. McDONALD GRAVEL SEARCH</b>	
Compiled and checked <b>P.A. LANG</b> Project geologist	Checked and approved  Senior geologist	To accompany Record 1973/153	Drawn by <b>C.M.</b> Drawing No. 155/A16/1082
Supervising geologist			